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Around 1000 BC. Absolute dates for the Final Bronze Age - Early Iron Age transition in Italy: wiggle-match 14C dating of two tree-trunk coffins from Celano

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Fibula from Tumulus 5, Celano (Abruzzo region, Italy). From d'Ercole 1998: La necropoli dell'età del Bronzo Finale delle "Paludi" di Celano (in: D'Ercole, V. & R. Cairoli (a cura di), *Archeologia in Abruzzo, Arethusa, Montalto di Castro* (VT), 157-166).

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Around 1000 BC

Absolute dates for the Final Bronze Age – Early Iron Age transition in Italy: wiggle-match ^{14}C dating of two tree-trunk coffins from Celano

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Abstract: At Celano (Abruzzo region, Italy), rare tumulus tombs of the Final Bronze Age were excavated, yielding waterlogged coffins of oak wood. Two tombs were dated by Wiggle-Match Dating (WMD), using the conventional ^{14}C method. This shows that the tumuli were erected around 1030 BC, while the associated artefacts in the sarcophagi are attributable to the final stages of the Bronze Age (FBA) in Italy. Fibulae similar to those found in both tombs at Celano are recovered in modest numbers all over the Italian peninsula and even in Croatia and nearby regions (Glogović 2003; von Merhart 1969, pls. 4, 5, 7).

Our date of ca. 1030 BC for the last stages of the Bronze Age in Italy has consequences for the beginning of the Iron Age, which should start around 1000–950 BC, an assessment that is consistent with other radiocarbon sequences obtained for Italy, such as the sequence for *Latium Vetus* and elsewhere in the western Mediterranean.

Keywords: Final Bronze Age, Early Iron Age, Italy, Celano, wiggle-match dating.

1. Introduction

The establishment of an absolute chronology of Italian pre- and protohistory by means of scientific methods such as dendrochronology and radiocarbon is still in progress (Bartoloni & Delpino 2005; Nijboer 2016). For example, the absolute chronology of the Early Iron Age in Italy is the subject of controversy. At a conference devoted to this topic, it was agreed by many that the Early Iron Age in Italy emerged around 950 BC (Peroni & Vanzetti 2005; Pacciarelli 2005; Nijboer 2005). But thus far there is no general consensus on absolute dates for events during the 9th and 8th centuries BC.

The present paper discusses a number of ^{14}C dates evaluated as precisely as possible for the transition from Bronze to Iron Age in Italy. The research is a combination of dendrochronology, ^{14}C dating and two sound archaeological contexts. We analyzed three tree-trunk coffins from Celano-Paludi, which contained artefacts pertaining to the final stages of the Bronze Age. Dendrochronological dating would establish the absolute age of the tree-trunk coffins. However, a dendrochronological standard curve is not available for the

period concerned in Italy, as it only covers the period from the present day back to medieval times. Moreover, the longest ones are constructed for coniferous wood, and not for the ancient Italian oak that was frequently used in prehistory (Martinelli 2005). As for dendrochronology and radiocarbon dating, only a limited number of dates is available for this phase. Most dendrochronological dates are of poor quality in terms of archaeological context and sample quality (Zanini & Martinelli 2005). The radiocarbon sequence for *Latium Vetus* covering the Final Bronze Age and Early Iron Age is an exception (Nijboer & van der Plicht 2008; Bietti Sestieri & de Santis 2008).

Therefore we applied the next best method: a combination of ^{14}C dating and tree-ring analysis, known as “Wiggle-Match Dating” or WMD (e.g. Bronk Ramsey *et al.* 2001). The contexts examined are Tombs 2, 4 and 5 from Paludi di Celano (d’Ercole 1998). The excavated waterlogged site is shown in Figure 1. The tree-trunk coffins are directly associated with the artefacts found in them (d’Ercole 1998). Thus, WMD currently offers the best way to establish absolute dates for the final phase of the Bronze Age in Italy.

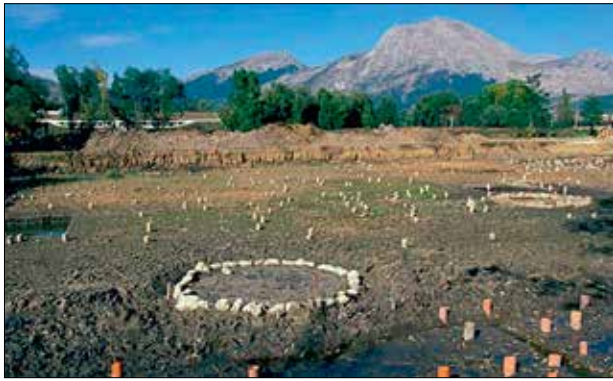


Fig. 1. The site of Celano where the tombs and coffins were excavated.
Copyright: Museo Preistorico di Celano.

2. Materials and methods

The archaeological museum (Museo della Preistoria) at Celano (L'Aquila) houses the archaeological artefacts from the necropolis of Paludi di Celano. During two sampling campaigns, the museum, Pignatelli & Martinelli, Tol & Nijboer selected wood remains from the necropolis suitable for WMD dating. The samples consist of fragments of the coffins from Tombs 2 and 5, and a cross section of the coffin from Tomb 4. Samples were selected on the basis of the length of the tree-ring sequences, the quality of the wood and the absence of preservatives. The waterlogged wood from Tomb 5 was excavated in 2002 and preserved in water in the Celano museum until sampling. The coffin from Tomb 4, well preserved and complete, had been left *in situ* after the excavations. It was still on the bottom of a small lake. To sample the wood from Tomb 4, the lake was drained.

Celano Tomb 2 held the remains of an adult female in her forties in a wooden coffin covered by a tumulus with a diameter of ca. 4 m, surrounded by a kerb of stones. Into the centre of the tumulus a pit had been dug, also

surrounded by stones, into which a tree-trunk coffin with the deceased had been placed. She was buried with a bronze fibula on her chest (d'Ercole 1998).

Celano Tomb 4 was covered by a tumulus with a diameter of 5 m, surrounded by a kerb of stones. The construction of the tumulus and grave is similar to that of Tomb 2. The coffin of 65 by 245 cm contained the body of an adult woman in her thirties. She was buried with a wooden comb, a needle and two fibulae that were found lying on the left side of her chest (see Figure 2).

Celano Tomb 5 is another tumulus almost 4 m in diameter marked by a kerb of stones (see Figure 5). Its construction is similar to the previous ones. The coffin contained the body of a child, aged 2 or 3 years, and therefore it was small in comparison to the tree-trunk coffins of adults also excavated at Paludi di Celano. The child was buried with a bronze fibula that is large considering the small body of the infant. The coffin of Tomb 5 measured approximately 125 by 35 cm; three fragments of it were sampled for dendrochronology.

According to data collected during the archaeological research, the coffins were each made from a single tree trunk of an oak tree (*Quercus* sp.) in Tombs 4 and 5, or from a beech tree (*Fagus*) in the case of Tomb 2 (d'Ercole 1998). At present it is impossible to determine whether the fragments from Tombs 2 and 5 come from the actual coffins or from the lids. The re-excavation of Tomb 4 allowed us to observe the entire wooden coffin and take the sample from one of the extremities of the lower part, where the wood-working had not been too invasive and a near-complete cross-section of the trunk was preserved.

Dendrochronological methods were applied by Dendrodata (Martinelli 2005; www.dendrodata.com) to provide secure tree-ring sequences. From each wood fragment a tree-ring sequence was recorded and

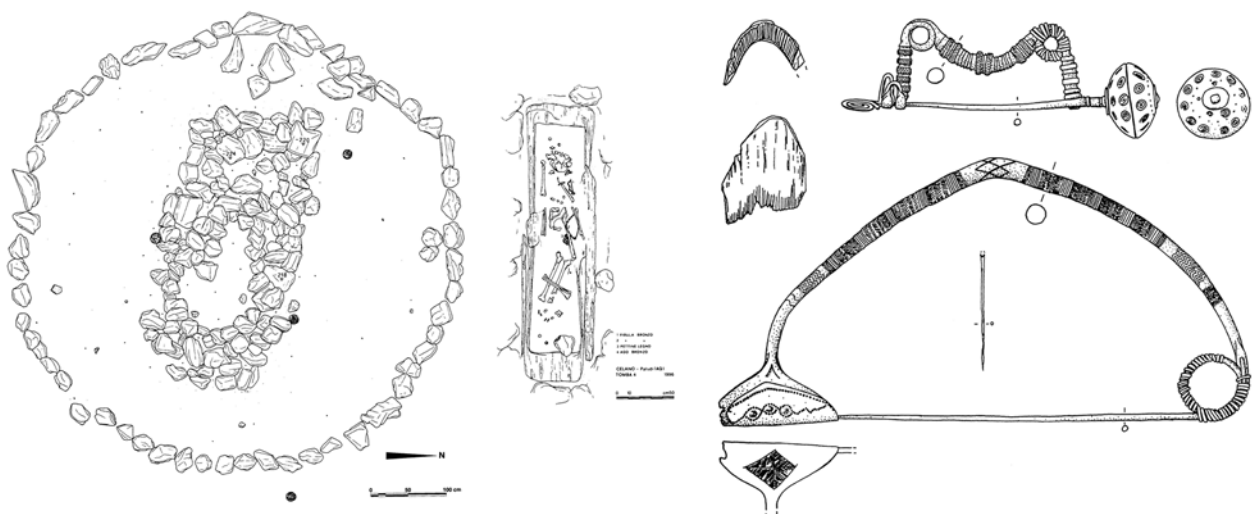


Fig. 2. Celano, Tumulus 4, plan and associated artefacts; calibrated WMD date of ca. 1055 BC. Figure Groningen Institute of Archaeology, after d'Ercole 1998: 157–166.

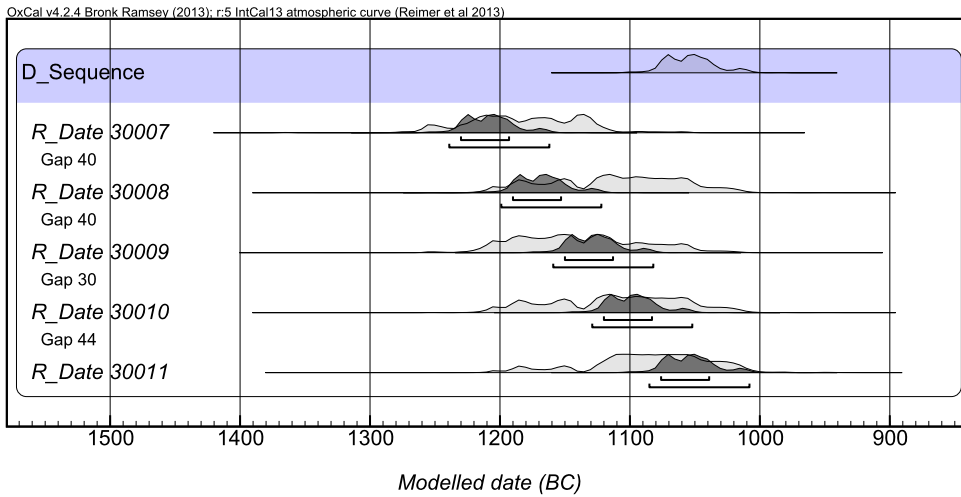


Fig. 3. Wiggle-match dating results for the tree-ring sequence of Celano Tomb 4. Graph: J. van der Plicht, Centre for Isotope Research, University of Groningen.

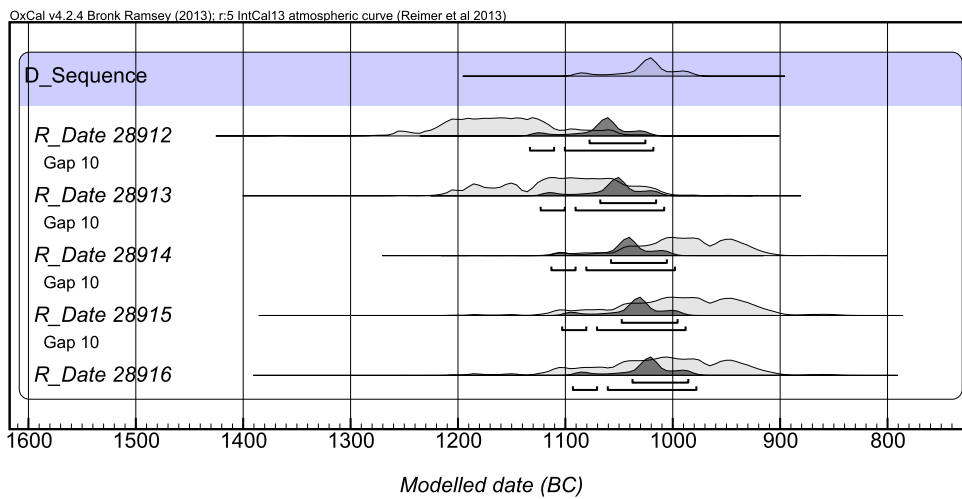


Fig. 4. Wiggle match dating results for the tree-ring sequence of Celano Tomb 5. Graph: J. van der Plicht, Centre for Isotope Research, University of Groningen.

subsequently cross-dated with the sequence from other fragments of the same coffin in order to obtain the definitive tree-ring series for each grave. Cross-dating was accomplished by means of well-established statistical parameters such as t_{BP} and GLK (see *e.g.* Baillie & Pilcher 1973). The resulting definitive floating sequences from the coffins are: 88 rings for Tomb 2, 168 rings for Tomb 4 and 62 rings for Tomb 5.

For Tombs 4 and 5, five samples, containing ten rings each, were prepared for radiocarbon and WMD dating. This was not feasible for Tomb 2, and therefore it is not discussed any further in this paper. The sequence of ^{14}C dates was matched to the calibration curve IntCal13 (Reimer *et al.* 2013) applying the D-sequence (wiggle-match) option of the program OxCal (Bronk Ramsey 2001).

The samples received standard pretreatment by AAA (Acid-Alkali-Acid) and were combusted and purified to CO_2 (Mook & Streurman 1983). The stable isotope ratios $\delta^{13}C$ were measured by Isotope Ratio Mass Spectrometry.

Large amounts of wood were available, allowing the use of conventional ^{14}C dating based on Proportional Gas

Counting (Cook & van der Plicht 2013). At the time, this yielded better measurement precision than AMS.

Table 1. Radiocarbon dates for tree-ring samples from Tombs 4 and 5 from Celano. Also the numbers of rings analysed and $\delta^{13}C$ values are shown.

GrN number	tomb	rings	^{14}C age (BP)	sigma	$\delta^{13}C$ (‰)
30007	4	1-10	2968	24	-27.42
30008	4	40-50	2918	25	-27.04
30009	4	80-90	2935	25	-26.50
30010	4	110-120	2917	25	-26.97
30011	4	150-168	2900	24	-26.03
28912	5	1-10	2951	30	-25.71
28913	5	11-20	2908	29	-26.01
28914	5	21-30	2835	30	-26.89
28915	5	31-40	2836	37	-26.92
28916	5	41-50	2845	40	-26.69

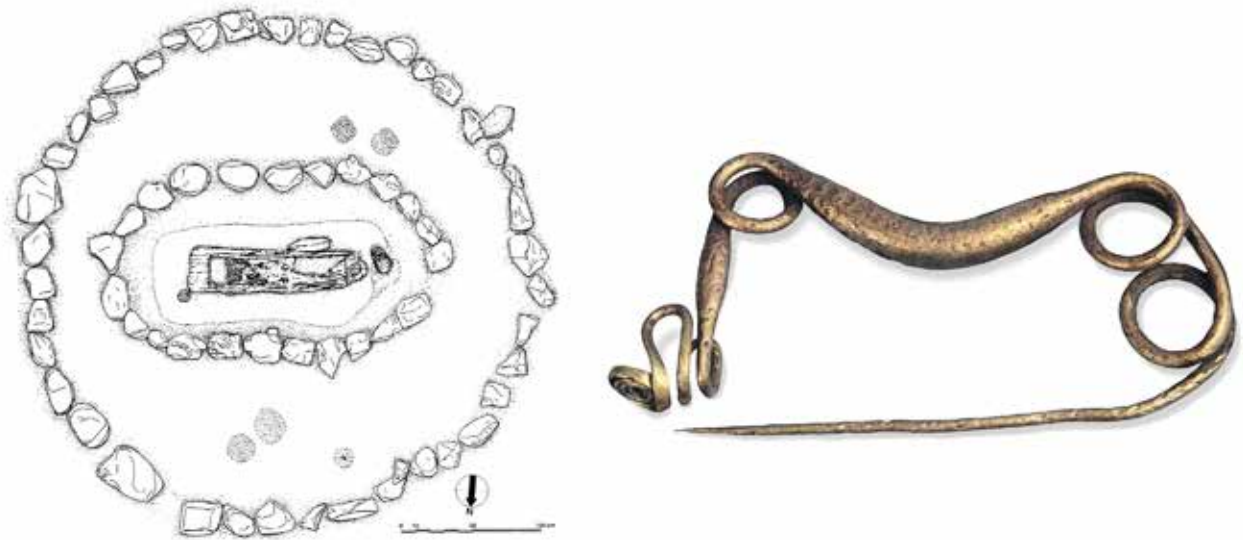


Fig. 5. Celano, Tumulus 5, plan and associated fibula; calibrated WMD date of ca. 1008 BC. Figure Groningen Institute of Archaeology, after d'Ercole 1998: 157-166.

3. Results

The radiocarbon dates obtained for the five-decadal ring samples for Tombs 4 and 5 are shown in Table 1. The tree-ring numbers are shown, the ^{14}C dates in BP (not rounded) and their 1-sigma uncertainty, and the $\delta^{13}\text{C}$ values in ‰ (PDB).

For each coffin, the sequence of ^{14}C dates was matched to the calibration curve IntCal13 (Reimer *et al.* 2013). The results of the match are shown in Figures 3 and 4 for Tombs 4 and 5, respectively. The calendar axis in both figures is given in calBC (calibrated ^{14}C years).

The resulting dates after the WMD are 1060 calBC for Tomb 4, and 1013 calBC for Tomb 5 (see Figures 3 and 4, respectively). The matching uncertainties are 20 and 25 years to either side for Tombs 4 and 5, respectively. The outermost rings of the tree trunk from Tomb 4 are of a different, lighter colour and tyloses are present in the vessels. This suggests the heartwood/sapwood transition zone; the amount of sapwood is estimated to be 5 years (N. Martinelli, personal communication). The numbers are slightly revised from those mentioned in Nijboer & van der Plicht 2008, because of minor revision in the calibration graph IntCal13.

4. Discussion

The absence of an Italian standard oak chronology for the Final Bronze Age (FBA) prevents the exact dating of the dendrochronological sequences obtained from the coffins of the Celano tombs. Nevertheless, wiggle-matching tree-ring sequences dated by ^{14}C produces felling dates around 1055 and 1010 BC for Tomb 4 and

Tomb 5, respectively. These results allow an assessment in relation to the available archaeological evidence.

The fibulae of the Final Bronze Age and Early Iron Age in Italy display a detailed stylistic development that can be sequenced in time, resulting in a relative chronology (Lo Schiavo 2010; Savella 2015). The type descriptions are precise, since most fibulae were still individually crafted and represent a kind of status symbol on account of their singularity. During the subsequent 9th and 8th centuries BC, copper-alloy fibulae were increasingly produced in series (Bietti Sestieri 1981).

Tomb 5 was the tomb of a child and contained only one fibula, described as a specific bronze, incised, serpentine fibula (D'Ercole 1998: 159-160). The fibula from this tomb is shown in Figure 5; comparable fibulae are found elsewhere in Italy, for example at Capua, in Rome, near Cerveteri, at Fratessina in NE Italy, and at Torre Galli in SW Italy (*cf.* Lo Schiavo 2010: 609).

Celano Tomb 4 has a comparable construction to Tomb 5, and contained the remains of a wooden comb, a needle and two fibulae (Fig. 2). Combs are found in some contexts in Italy during the Final Bronze Age (Betelli & Damiani 2005). Since the comb of Celano Tomb 4 is fragmentary and lacks further stylistic features, it is not discussed in detail.

The two fibulae of Celano Tomb 4 are typologically described by D'Ercole & Savella as a particular bow and a serpentine fibula (D'Ercole 1998: 158; Savella 2015; 2016). Comparable fibulae are found in Old Latium (phase Tolfia and Roma-Colli Albani or Latium period I), in Campania and in Basilicata (*cf.* Lo Schiavo 2010: 126-8, 637-8). These three fibulae from Celano (Figs. 2 and 5) with WMD dates are considered guide types for the last phase of the Italian Final Bronze Age, abbreviated

as FBA 3 (cf. Peroni 1994: 181-184; Savella 2015; 2016). It is the phase that immediately preceded the Early Iron Age (EIA 1). In the following we contextualize the Celano WMD results both in relation to equivalent radiocarbon results of the Final Bronze Age (FBA 3) in Italy, and in relation to the first phase of Early Iron Age (EIA 1). Hence it also briefly examines data on the introduction in Italy of the novel metal iron.

The WMD results are in line with radiocarbon analyses elsewhere in central Italy. Table 2 provides a list of typical FBA 3 fibulae with associated radiocarbon dates. Some of these fibula types are assessed by Savella as marking the transition from Bronze to Iron Age. This transition was gradual, and is frequently not directly associated with the metal iron but characterized by the development of other cultural markers (cf. Bietti Sestieri & De Santis 2008).

Table 2 and the WMD results from the Celano tombs reveal that the final phase of the Bronze Age (FBA 3) in Italy is dated by ^{14}C to the decades around 1030 BC. This matches the proposition by Weninger & Jung who assigned the previous phase of the Final Bronze Age (FBA 2) to 1070 - 1040 BC (Weninger & Jung 2009: 389-91). Their suggestion is based on indirect chronological associations for Italy, but coincides well with the direct WMD result for Celano Tomb 4 (ca. 1055 BC) and Tomb 5 (ca. 1010 BC), both containing specific types of fibula that were recently contextualized and assigned to FBA 3 (Savella 2015; 2016).

Table 2 further indicates that the subsequent Iron Age in Italy started in the decades around 975-950 BC and not around 900 BC as maintained in the Conventional Absolute Chronology (cf. Bietti Sestieri & De Santis 2008; Nijboer & Van der Plicht 2008).

The introduction of iron in the western Mediterranean is currently much debated, owing to new radiocarbon research focusing on the Early Iron Age. It seems that in several regions of Europe the Iron Age emerged considerably earlier than previously thought. For instance, in Central Europe the beginning of the Iron Age, known to archaeologists as Hallstatt C, is no longer dated to 725 BC but to 800 BC thanks to dendrochronological data (Friedrich & Hennig 1996; Pare 1996; 1998; 2000). The same is becoming clear for the Iberian peninsula, due to radiocarbon research associated with archaeological contexts containing early iron. In Spain and Portugal quite a few excavations have revealed early iron tools in contexts radiocarbon-dated to around 2900-2800 BP (Vilaça 2006; 2013). The early use of iron is one of the characteristics of the Orientalizing phenomenon in Spain (cf. Neville 2007) and is related to emerging Phoenician contacts (cf. Mielke & Torres Ortiz 2012; Kaufman *et al.* 2016). The ^{14}C analyses suggest a date as early as the 12th century BC for the first iron artefacts on the Iberian peninsula, but in this paper we examine

mainly the late 11th and 10th century BC, for which the evidence is considered to be more sound.

Quite a few EIA 1 sites in Italy reveal a limited range of iron artefacts, which might be due to differential preservation, local deposition customs or reuse of iron at a time when the demand for iron was rapidly increasing. Nonetheless there are two sites in Italy which indicate that iron started to replace copper alloys as the basic metal for tools and weapons during the 10th and 9th centuries BC: Torre Galli on the Tyrrhenian coast of Calabria and the inland site of Fossa in the Abruzzo region, near Celano (Nijboer 2018).

At Torre Galli, roughly 25% of the 205 Early Iron Age tombs contained iron artefacts, indicating that at this site it was no longer an exceptional metal during EIA 1. In addition, Torre Galli is known for its imports from the Levant (Sciaccia 2011), while the site is not associated with early imports from Euboea or other parts of modern Greece. Its Aegyptiaca belong to the oldest found on the Italian peninsula (De Salvia 1999: 213-217).

More relevant for the present argument is evidence from the necropolis at Fossa, which is located ca. 40 km north of Celano. The associated radiocarbon dates from graves document a fairly rapid advance in the use of iron as a metal for tools, ornaments and weapons. The construction of the early Fossa tombs still has much in common with the Celano tumuli presented above, though the associated artefacts are quite different. The evidence for this region indicates that iron replaced copper as the basic metal for tools and weapons in the course of ca. 175/150 years, during the period 975/950 to 800 BC. The necropolis of Fossa itself was in use for eight centuries, having emerged during the late 9th century BC as confirmed by ^{14}C dates of some tombs assigned to its earliest phase (Fossa 1A):

- Fossa Tomb 56 is dated to 2660 \pm 40 BP (GX-26588-AMS),
- Fossa Tomb 100 to 2650 \pm 40 BP (GX-26584-AMS)
- Fossa Tomb 190 to 2630 \pm 40 BP (GX-26583-AMS) (Castiglioni & Rottoli 2004: 233).

The calibrated dates (1 σ , rounded to 5) are 890-795, 830-790 and 895-770 calBC, respectively.

These radiocarbon dates from Fossa match those from other regions in Italy (Nijboer & Van der Plicht 2008).

This dates Fossa 1A to the late 9th and early 8th century BC since the radiocarbon calibration curve is quite steep around this time, resulting in relatively precise absolute dates. In addition, it is relevant to our discussion on the Early Iron Age in Italy to note that these early tombs contain more tools, weapons and ornaments in iron than in bronze (Cosentino *et al.* 2001: 83-5; 94; 104-7). All in all, 14 tombs could be assigned to Fossa phase 1A, and each of them contains iron. The repertoire of iron artefacts during this phase, sometimes combined with elements in copper alloy, consists of various types

Table 2. *Paludi di Celano fibulae with WMD date, compared with similar fibulae from the final stage of the Bronze Age and the beginning of the Iron Age in Italy, especially of the serpentine type, with associated ^{14}C dates (Savella 2015; group B refers to bow fibulae and group C are serpentine fibulae) or Latial period I and I/II (Bietti Sestieri & De Santis 2008).*

Context	WMD date	Radiocarbon date	Fibula type, according to Savella 2015; 2016 + relative chronology	Relative chronology for Latium Vetus according to Bietti Sestieri & De Santis 2008	Refs.
Celano, Tomb 4	ca. 1055 BC	Five-decadal analysis; see this paper	Type B16 FBA 3 B stands for a bow fibula	Abruzzo	Savella 2016. Nijboer & Van der Plicht 2008. This paper.
Celano, Tomb 4	ca. 1055 BC	Five-decadal analysis; see this paper	Type C15 FBA 3 C stands for a serpentine fibula	Abruzzo	Nijboer & Van der Plicht 2008. This paper.
Celano, Tomb 5	ca. 1008 BC	Five-decadal analysis; see this paper	Type C 10 FBA 3	Abruzzo	Nijboer & Van der Plicht 2008. This paper.
Montetosto Alto, Tomb 4	-	2870 +/- 35 GrA-26663	Type C 12 FBA 3 / EIA 1 southern Etruria, near Cerveteri		Trucco <i>et al.</i> 1999. Pacciarelli 2000, 205-7.
Quadrato, Tomb 1	-	2810 +/- 50 GrA-16411	Type C4 FBA 3 / EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
Quadrato, Tomb 2	-	2820 +/- 50 GrA-16423	Type C4 FBA 3 / EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
Foro di Cesare, Tomb 2	-	2770 +/- 60 GrA-16433	Type C4 FBA 3/EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
S. Palomba, Tomb 2	-	2865 ± 40 BP GrA-27847	Type C16 FBA 3 / EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
Santa Palomba, Tomb 2	-	2865 ± 40 BP GrA-27847	Type C17 FBA 3	Latial period 1	Nijboer & Van der Plicht 2008.
Santa Palomba, Tomb 1	-	2875 ± 35 BP GrA-27028	Three serpentine fibulae; no type indication. EIA 1 or beginning of Iron Age	Latial period 1	Nijboer & Van der Plicht 2008.
Celano, Tomb 4	ca. 1055 BC	Five-decadal analysis; see this paper	Type B16 FBA 3 B stands for bow fibulae	Abruzzo	Savella 2016. Nijboer & Van der Plicht 2008. This paper.
Celano, Tomb 4	ca. 1055 BC	Five-decadal analysis; see this paper	Type C15 FBA 3 C stands for serpentine fibulae	Abruzzo	Nijboer & Van der Plicht 2008. This paper.
Celano, Tomb 5	ca. 1008 BC	Five-decadal analysis; see this paper	Type C 10 FBA 3	Abruzzo	Nijboer & Van der Plicht 2008. This paper.
Montetosto Alto, Tomb 4	-	2870 +/- 35 GrA-26663	Type C 12 FBA 3 / EIA 1 southern Etruria, near Cerveteri		Trucco <i>et al.</i> 1999. Pacciarelli 2000, 205-7.
Quadrato, Tomb 1	-	2810 +/- 50 GrA-16411	Type C4 FBA 3 / EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
Quadrato, Tomb 2	-	2820 +/- 50 GrA-16423	Type C4 FBA 3 / EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
Foro di Cesare, Tomb 2	-	2770 +/- 60 GrA-16433	Type C4 FBA 3/EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
S. Palomba, Tomb 2	-	2865 ± 40 BP GrA-27847	Type C16 FBA 3 / EIA 1	Latial period 1	Nijboer & Van der Plicht 2008.
Santa Palomba, Tomb 2	-	2865 ± 40 BP GrA-27847	Type C17 FBA 3	Latial period 1	Nijboer & Van der Plicht 2008.
Santa Palomba, Tomb 1	-	2875 ± 35 BP GrA-27028	Three serpentine fibulae; no type indication. EIA 1 or beginning of Iron Age	Latial period 1	Nijboer & Van der Plicht 2008.

of fibula including later serpentine fibulae, large and small knives, lances, shafts, short swords, scabbards, pins, typical cut-out discs, bracelets, pendants, rings, hooks and plates (Cosentino *et al.* 2001; 2004). Local ironworking is demonstrated by the wide repertoire of iron artefacts of which some are typical for this part of Italy, such as the cut-out discs and other ornaments. The deposition of numerous types of iron weapons, tools and ornaments at Fossa continues over the subsequent centuries.

Around 800 BC there are no materials or artefacts at Fossa that record direct or indirect contacts with the Levant or Euboea, but connections do exist with the Villanovan or Early Iron Age network of settlement centres in Italy, given the presence of some artefacts with an interregional distribution. These indicate that the technology of ironworking in and around Fossa was transmitted through an overland network of local centres that became established during EIA 1. The dense network of Early Iron Age settlement centres, incorporating amongst others Fossa as reflected in some of the Villanovan artefacts deposited there, seems to have contributed significantly to the spread of ironworking in Italy during the 9th century BC. In addition, the radiocarbon dates for Italy indicate that the definitive introduction and adoption of iron is not related to contacts with the Aegean or Greece. This matches the radiocarbon results from Spain/Portugal (Vilaça 2006; 2013). In fact, the combined data reveal a chronological break in Aegean links with Italy. During the preceding FBA 1 and FBA 2 one can still detect traces of such connections (*cf.* Savella 2015; Iacono 2015) but they no longer seem to exist from FBA 3 onwards. At the beginning of EIA II, around 800 BC, there are links with Euboeans once again. In radiocarbon terms, the gap is evident between ca. 2800 and 2550 BP (ca. 1000-700 BC) (Nijboer 2016). In the period between ca. 1030 and 800/775 BC, developments on the Italian peninsula appear to have been quite independent from those in present-day Greece. FBA 3 and EIA I are however associated with Phoenicians from present-day Lebanon. The indigenous-Phoenician deposits at Huelva (SW Spain) and Utica (Tunis) yielded radiocarbon dates around 2790-2760 BP (ca. 1000-800 BC) (López Castro *et al.* 2016). The recent excavations at Utica provided a context that is dated to the 9th century BC, or even to the late 10th century BC. López Castro and his co-authors interpret the evidence from Utica as the first stage towards a permanent settlement, and therefore define the finds as the most ancient horizon of the Phoenician colonization in the central and western Mediterranean. The radiocarbon dates pertain to a disused water-well filled with waste and linked to a building. The associated radiocarbon dates indicate the period 925-850 BC. The contents of the well are striking, since they contain ceramics of mainly Libyan and Phoenician origin (ca. 65%); the rest of the pottery consists of local

imitations of Phoenician vessels, Sardinian, Greek, Villanovan and Tartessian ceramics (in order of decreasing proportions). The assemblage records the wide exchange network maintained by the Phoenicians all over the western Mediterranean, including Iron Age (Villanovan) ceramics from mainland Italy from at least the 9th century BC onwards. It supports the notion of Villanovan contacts with Phoenicians prior to the arrival of the Euboeans (*cf.* Nijboer 2016).

Table 2, listing similar fibulae and contexts in combination with the WMD results, indicates that the characteristic fibulae from Paludi di Celano in Tombs 4 and 5 should be assigned to the final stages of the Bronze Age, dating to the late 11th century BC. To the fibulae of Tombs 4 and 5 from Celano as a group we assign a date in the period 1050-1000 BC, since the construction of both tombs is very similar and the artefacts are contemporaneous, though Tomb 4 appears to be a few decades older than Tomb 5.

The tombs in which these fibulae are found in Italy are exceptional, and belong to the group of early high-status tombs preceding the elite tombs of the advanced Iron Age (Pacciarelli 2000: 202-16). Celano di Paludi Tombs 4 and 5 are remarkable on account of their elaborate construction and funerary ritual. The roughly contemporaneous Monte Tosto Alto Tombs 1 and 4 (Tomb 4 is dated 2870±35 BP, calibrated 1110-1000 calBC, GrA-26663) are described as burials reflecting an evolved stage of social development, on account of the tomb furnishings with large numbers of symbolic funerary gifts and the large fibulae (Trucco *et al.* 1999). This also applies to the contemporary tomb furnishings in and near Rome. Tomb 2 at the Foro di Cesare besides ritual ceramics contained a miniature knife, a miniature lance and miniature double shields (Bietti Sestieri & De Santis 2000: 14-15; Table 2). Tomb 2 at Roma, via Tuscolana, località Quadrato is a double cremation tomb of a man and a woman containing ritual ceramics and a miniature knife, lance and razor (Bietti Sestieri & De Santis 2000: 25; Table 2). As Bietti Sestieri & De Santis wrote, the miniature grave goods in *Latium Vetus* period I are faithful reproductions of everyday artefacts, while some of them such as the knife, double shields and sword, mark main military/political and religious roles of the buried individuals (Bietti Sestieri & De Santis 2008: 123-5). Similar tombs in *Latium Vetus*, furnished with miniature weapons and other symbolic artefacts, are forerunners of the much more elaborate warrior tombs of the advanced Iron Age (EIA 2) and the early Orientalizing period in central Italy. In addition, the limited number of identified 11th- and 10th- century BC tombs implies restricted access to formal burial. This controlled access was abandoned during the Iron Age, leading to the extensive Iron Age necropolises at for example Bologna, Tarquinia, Veio and Pontecagnano.

The selection of Final Bronze Age tombs in central Italy and Celano discussed here represent individuals that had some standing in their communities. They also embody those individuals who were involved in wider communication networks and centralisation processes, which are documented especially for southern Etruria. It is around this time that in southern Etruria the vast majority of small Final Bronze Age sites were abandoned, and that habitation centres on the larger plateaux became the primary towns of future Etruscan city states (cf. Pacciarelli 2000: 104-8). It is around this time as well that the Latins emerged as a cultural entity, which is reflected in the term Latial Period I (Table 2).

The WMD results of both tombs at Celano point to the last stage of the Final Bronze Age in Italy, and the period 1050 to 1000 BC. The combination of dendrochronology, the radiocarbon method and archaeology allowed us to date both tombs quite precisely, compared to the wide calibration ranges normally obtained from radiocarbon dates as presented in Table 1. The period FBA 3 is dated to 1050-1000 BC, and this confirms our assessment that the Iron Age in Italy emerged during the 10th century BC. A more precise time-depth reconstruction of this period in Italian history is currently not feasible, since it would require more dendrochronological data: WMD results in combination with meaningful archaeological contexts.

5. Conclusion

By wiggle-match dating of oak wood from two coffins, we have shown that the tumuli at Celano (Italy) were erected around 1030 BC. The archaeological assemblages with the characteristic fibulae point to the final stages of the Bronze Age (FBA 3). This suggests that the Early Iron Age in Italy started no later than 975-950 BC. This is consistent with other data from various Italian sites such as *Latium Vetus* (Nijboer & Van der Plicht 2008), as well as with radiocarbon data associated with the introduction of iron on the Iberian peninsula (cf. Mielke & Torres Ortiz 2012; Nijboer 2018). It also reinforces an older ("higher") chronology for the Early Iron Age I in Italy than the conventional archaeological chronology. All this matches the higher dates for the emergence of the Iron Age in Central Europe and in other parts of the western Mediterranean, based on the results of current scientific dating methods.

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